

WHAT IS CLAIMED IS:

1. A method of analyzing a hydraulic pump in real-time, the method comprising:

providing a pressure signal representing a discharge pressure of the hydraulic pump;

decomposing the pressure signal into a plurality of levels, each of the plurality of levels having at least one frequency band;

locating a feature pressure signal in at least one of the frequency bands;

comparing the located feature pressure signal wavelet to a reference wavelet.

2. The method of claim 1 wherein said comparing comprises: determining a wavelet coefficient between the feature pressure signal and the reference wavelet.

3. The method of claim 1 wherein said comparing comprises: performing wavelet transform on the feature pressure signal.

4. The method of claim 2 further comprising: identifying a fault in the hydraulic pump if the wavelet coefficient exceeds a predetermined threshold, wherein the threshold comprises a wavelet coefficient representing an amount of difference between a feature pressure signal of a hydraulic pump not having the fault, and the reference wavelet.

5. The method of claim 1 wherein the reference wavelet is selected by:

providing a characteristic pressure signal representing discharge pressure of a hydraulic pump having a known condition;

decomposing the provided characteristic pressure signal into a plurality of levels, each of the levels having at least one frequency band;

determining the reference wavelet, wherein the reference wavelet is similar to a number of data points within at least one of the frequency bands.

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6. The method of claim 5 wherein said determining the reference wavelet comprises:

identifying at least one candidate feature signal, each of the at least one candidate feature signals being for a range of data points within at least one of the frequency bands;

determining a difference between each of the at least one candidate feature signals and the reference wavelet;

identifying the reference wavelet having the smallest difference from one of the identified candidate feature signals.

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7. The method of claim 2 further comprising:

at least one of scaling and shifting the located feature pressure signal before said step of determining a wavelet coefficient;

wherein said step of determining comprises determining a wavelet coefficient between the scaled and/or shifted feature pressure signal and the reference wavelet.

8. The method of claim 1 wherein the frequency band comprises a high-frequency band for the decomposition level.

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9. The method of claim 1 wherein said providing comprises receiving a direct discharge pressure from the pump.

10. The method of claim 1 wherein the discharge pressure comprises pulsation discharge pressure of the pump.

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11. The method of claim 1 wherein the step of providing comprises:

providing a pressure sensor in fluid communication with a discharge port of a hydraulic pump;

5 receiving pulsation discharge pressure from the hydraulic pump;

generating the evaluating signal.

12. The method of claim 10 wherein the pump comprises an axial piston fixed displacement hydraulic pump.

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13. The method of claim 11 wherein the pressure sensor is installed on the discharge port of the pump.

14. The method of claim 1 wherein the reference wavelet comprises at least one of a Harr wavelet, a Daubechies wavelet, and a Morlet wavelet.

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15. The method of claim 1 wherein the pressure signal is sampled at discrete data points associated with discrete time steps.

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16. The method of claim 1 wherein said step of decomposing comprises:

filtering the pressure signal using a low pass filter and a high pass filter.

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17. An apparatus for identifying a defect in a hydraulic system comprising:

a pressure sensor in fluid communication with a discharge port of a hydraulic pump of the hydraulic system, the pressure sensor being configured to produce a pressure signal in response to a received pulsation discharge pressure;

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a processor coupled to the pressure sensor, the processor being configured to:

receive the pressure signal;

5 decompose the pressure signal into a plurality of levels, each of the plurality of levels having at least one frequency band;

locate a feature pressure signal in at least one of the frequency bands;

compare the located feature pressure signal to a reference wavelet.

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18. A hydraulic system comprising:

a hydraulic pump configured to distribute a fluid through at least one passage;

15 a pressure sensor in fluid communication with a discharge port of a hydraulic pump of the hydraulic system, the pressure sensor being configured to produce a pressure signal in response to a received pulsation discharge pressure;

a processor coupled to the pressure sensor, the processor being configured to:

20 receive the pressure signal;

decompose the pressure signal into a plurality of levels, each of the plurality of levels having at least one frequency band;

locate a feature pressure signal in at least one of the frequency bands;

25 compare the located feature pressure signal wavelet to a reference wavelet.